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(54) PLASMA DISPLAY MEMBER AND MANUFACTURE THEREFOR AND PLASMA DISPLAY

(57)Abstract:
PROBLEM TO BE SOLVED: To improve display contrast, and to prevent cross talk in a discharge space by setting a stimulation value in an XYZ display color system of a barrier rib not more than a specific value, and setting a lengthwise directional recess/ projection of the barrier rib top part to a specific value range.
SOLUTION: A back face glass substrate for a plasma display forming a barrier rib is sealed with a front glass substrate in the top part of a barrier rib to constitute a PDP(plasma display panel). A lengthwise directional recess/ projection of the barrier rib top part is controlled in 0.5 to 10 μm, more desirably, 0.5 to 5 μm to prevent cross talk of the plasma display. A stimulation value Y in an XYZ display color system of the barrier rib is set not more than 20 to improve display contrast. An optical density (reflection OD) value of the black part of the barrier rib is set not less than 1.3, more desirably, not less than 1.5, further desirably, not less than 1.6.

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CLAIMS

[Claim(s)]
[Claim 1] The member for plasma displays characterized by being the plasma display which has a septum on a substrate, and for the stimulus value Y in the XYZ color system of a septum being 20 or less, and the irregularity of the longitudinal direction of a septum crowning being 0.5-10 micrometers.
[Claim 2] The member for plasma displays to which the stimulus value Y in the XYZ color system of the septum upper part is 20 or less, and the septum lower part is characterized by white or the transparent thing by being the plasma display which has a septum on a substrate, and a septum consisting of two-layer at least.
[Claim 3] The member for plasma displays according to claim 1 or 2 whose reflective OD value of a septum is 1.3 or more and which comes out and is characterized by a certain thing.
[Claim 4] Claims 1-3 characterized by a septum being a stripe configuration are the members for plasma displays of a publication either.
[Claim 5] Claims 1-4 characterized by the line breadth of a septum crowning being 5-80 micrometers are the members for plasma displays of a publication either.
[Claim 6] Claims 1-5 characterized by for the pitch of a septum being 100-250 micrometers, and height being 50-170 micrometers are the members for plasma displays of a publication either.
[Claim 7] The member for plasma displays according to claim 2 characterized by for the thickness of the height direction of the black part of the septum upper part being 5-50 micrometers, and the thickness of the white of the septum lower part or the height direction of a transparence part being 20-150 micrometers.
[Claim 8] The member for plasma displays according to claim 1 characterized by the chromaticity-coordinate value x of a septum and the value of y being 0.3-0.36, respectively.
[Claim 9] The member for plasma displays according to claim 2 characterized by the chromaticity-coordinate value x of the septum upper part and the value of y being 0.3-0.36, respectively.
[Claim 10] Claims 1-9 characterized by consisting of glass ingredients whose septa are 450-550 degrees C of glass transition points and 500-600 degrees C of softening temperatures are the members for plasma displays of a publication either.
[Claim 11] Claim 10 characterized by the septum consisting of accounts of an oxide conversion chart with the glass ingredient of the following presentation is the member for plasma displays of a publication either.
Lithium oxide : 3 - 15-% of the weight oxidation silicon : 10 - 30-% of the weight oxidation boron : 20 - 40-% of the weight barium oxide : 2 - 15-% of the weight aluminum oxide : It is [Claim 12] ten to 25% of the weight. Claims 1-11 characterized by a septum containing 50 - 90 % of the weight of glass ingredients which are 450-550 degrees C of glass transition points and 500-600 degrees C of softening temperatures, and 10 - 50 % of the weight of fillers are the members for plasma displays of a publication either.
[Claim 13] The member for plasma displays according to claim 12 characterized by the thing for which the filler was chosen from the group which consists of titanium oxide, an alumina, barium titanate, a zirconia, cordierite, a mullite, and a high-melting glass ingredient, and which is a kind at least.
[Claim 14] The member for plasma displays according to claim 13 characterized by a high-melting glass ingredient including the presentation following in the account of an oxide conversion chart.
Oxidation silicon : 15 - 50-% of the weight boron oxide : 5 - 20-% of the weight aluminum oxide : 15 - 50-% of the weight barium oxide : It is [Claim 15] two to 10% of the weight. Claims 1-14 to which a septum is characterized by the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Co, Cu, Pb, or Bi containing three to 20% of the weight in total are the members for plasma displays of a publication either.
[Claim 16] Claims 1-15 characterized by the softening temperature of the glass powder contained in the septum upper part being lower than the softening temperature of the glass powder contained in the septum lower part 10-50 degrees C are the members for plasma displays of a publication either.
[Claim 17] The manufacture approach of the member for plasma displays which is the manufacture approach of the member for plasma displays which forms a septum on a substrate, and is characterized by a glass paste containing the metals or those oxide of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co three to 20% of the weight in total using the glass paste which consists of glass particles and an organic component.
[Claim 18] The manufacture approach of the member for plasma displays characterized by containing the metals or those oxide of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co three to 20% of the weight in total during the paste which forms the septum upper part by being the manufacture approach of the member for plasma displays which forms a septum on a substrate, and a septum consisting of two-layer at least using the glass paste which consists of glass

particles and an organic component.
[Claim 19] The manufacture approach of the member for plasma displays according to claim 18 characterized by being lower than the softening temperature of the glass powder which the paste whose softening temperature of the glass powder contained during the paste which forms the septum upper part forms the septum lower part contains 10-50 degrees C.
[Claim 20] Claims 1-16 are the plasma displays characterized by using the member for plasma displays of a publication either.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the plasma display used suitable for large-sized television, a computer screen, etc., and its manufacture approach.
[0002]
[Description of the Prior Art] Since a high-speed display is possible for a plasma display panel (henceforth PDP) compared with a liquid crystal display panel and enlargement is easy, fields, such as OA equipment and a public-relations indicating equipment, are permeated, and the progress to the field of a high definition television etc. is expected very much.
[0003] With expansion of such an application, it is highly minute and the color PDP which has many display cels attracts attention. PDP makes the anode and the cathode inter-electrode which counter produce plasma discharge in the discharge space prepared between the front-windshield substrate and the tooth-back glass substrate, and displays by hitting the ultraviolet rays generated from the gas enclosed in the above-mentioned discharge space to the fluorescent substance in discharge space. In this case, at the same time it holds down the breadth of discharge to a fixed field and makes a display perform within a regular cel, and in order to secure uniform discharge space, the septum (it is also called an obstruction and a rib) is formed.
[0004] Although the tooth-back glass substrate and front-windshield substrate with which this septum was formed are sealed and discharge space is formed in PDP, there is a problem that generating of the crack resulting from the overall curvature of a glass substrate etc. or poor sealing takes place, and it is known that malfunction generating of the cross talk which results from the very small irregularity which exists in a septum crowning further will also serve as a serious defect. It has been a technical problem very important for implementation of the improvement in the yield of PDP production, or its enlargement to cancel generating of such a defect.
[0005] Furthermore, a septum must be contributed also to raising contrast in display grace while it has the role which reflects the display light emitted from a fluorescent substance layer, and raises brightness. Thus, while fully raising the contrast effectiveness of a display, it is requested strongly that the plasma display which has the good black septum of the surface smooth nature which does not cause malfunction of a cross talk etc. should be manufactured efficiently.
[0006] The black septum which the black septum was indicated by JP,8-255563,A and changed the presentation of the upper layer and a lower layer into JP,6-150828,A is indicated.
[0007]
[Problem(s) to be Solved by the Invention] However, any septum had inadequate display contrast and prevention of a cross talk was also inadequate.
[0008] The purpose of this invention offers the plasma display which does not produce the cross talk in discharge space while the contrast of a display is excellent.
[0009] Other purposes of this invention are to offer the manufacture approach of a plasma display of manufacturing the above-mentioned plasma display efficiently.
[0010]
[Means for Solving the Problem] That is, this invention is a member for plasma displays characterized by being the plasma display which has a septum on a substrate, and for the stimulus value Y in the XYZ color system of a septum being 20 or less, and the irregularity of the longitudinal direction of a septum crowning being 0.5-10 micrometers.
[0011] Moreover, it is the plasma display which has a septum on a substrate, and a septum consists of two-layer at least, the stimulus value Y in the XYZ color system of the septum upper part is 20 or less, and this invention is a member for plasma displays to which the septum lower part is characterized by white or the transparent thing.
[0012] The member for plasma displays of this invention has the following desirable mode further.
[0013] (1) Said septum should be a stripe configuration.
[0014] (2) The line breadth of said septum crowning should be 5-80 micrometers.
[0015] (3) The pitch of said septum is 100-250 micrometers, and height should be 50-170 micrometers.
[0016] (4) The black part of said septum upper part is 5-50 micrometers, and the white part (white or transparence part) of this septum lower part should be 20-150 micrometers.
[0017] (5) Said septum or the chromaticity-coordinate value x of this septum upper part, and the value of y should be 0.3-0.36, respectively.

[0018] (6) Consist of glass ingredients said whose septa are 450-550 degrees C of glass transition points, and 500-600 degrees C of softening temperatures.
[0019] (7) Consist of glass ingredients of the following presentation of said septum with the account of an oxide conversion chart.
Lithium oxide : 3 - 15-% of the weight oxidation silicon : 10 - 30-% of the weight oxidation boron : 20 - 40-% of the weight barium oxide : 2 - 15-% of the weight aluminum oxide : 10 - 25 % of the weight.
[0020] (8) Contain 50 - 90 % of the weight of glass ingredients said whose septa are 450-550 degrees C of glass transition points, and 500-600 degrees C of softening temperatures, and 10 - 50 % of the weight of fillers.
[0021] (9) said filler was chosen from the group which consists of titanium oxide, an alumina, barium titanate, a zirconia, cordierite, a mullite, and a high-melting glass ingredient -- it is a kind at least.
[0022] (10) Said high-melting glass ingredient should include the presentation of the following [the account of an oxide conversion chart].
Oxidation silicon : 15 - 50-% of the weight boron oxide : 5 - 20-% of the weight aluminum oxide : 15 - 50-% of the weight barium oxide : 2 - 10 % of the weight.
[0023] (11) Said septum should contain the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co three to 20% of the weight in total.
[0024] (12) The softening temperature of the glass powder contained in said septum upper part is lower than the softening temperature of the glass powder contained in this septum lower part 10-50 degrees C. By the above-mentioned configuration, the plasma display of this invention can prevent a cross talk while the high display of contrast is attained.
[0025] Moreover, this invention is the manufacture approach of the member for plasma displays which forms a septum on a substrate using the glass paste which consists of glass particles and an organic component, and is the manufacture approach of the member for plasma displays characterized by a glass paste containing the metals or those oxide of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co three to 20% of the weight in total.
[0026] Moreover, this invention is the manufacture approach of the member for plasma displays which forms a septum on a substrate using the glass paste which consists of glass particles and an organic component, and is the manufacture approach of the member for plasma displays characterized by containing the metals or those oxide of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co three to 20% of the weight in total during the paste which forms the septum upper part by a septum consisting of two-layer at least.
[0027] Moreover, the manufacture approach of the member for plasma displays of this invention is included as a mode with desirable it being lower than the softening temperature of the glass powder which the paste whose softening temperature of the glass powder contained during the paste which forms the septum upper part forms the septum lower part contains 10-50 degrees C.
[0028] Moreover, this invention is a plasma display characterized by using the above-mentioned member for plasma displays.
[0029]
[Embodiment of the Invention] The stimulus value Y in an XYZ color system is 20 or less, and the septum of the plasma display of this invention is characterized by the irregularity of the longitudinal direction of a septum crowning being 0.5-10 micrometers.
[0030] Sealing of the tooth-back glass substrate for plasma displays with which the septum was formed is carried out to a front-windshield substrate in the crowning of a septum, and PDP is constituted. The cross talk of a plasma display can be prevented by controlling the irregularity of the longitudinal direction of a septum crowning more preferably to 0.5-10 micrometers at 0.5-5 micrometers. If irregularity exceeds 10 micrometers, perfect sealing becomes difficult, the cross talk of discharge space happens, and since it is discharge, the function as a display will be spoiled. Moreover, it is quite difficult technically to control irregularity to less than 0.5 micrometers.
[0031] The sensing-pin type which senses irregularity by the sensing pin can be used for the measurement approach of the irregularity of a septum crowning. Measurement sets up a needle on a septum crowning, and the longitudinal direction of a septum is made to scan it, and it computes the difference of the peak price of the measured value in measuring range, and the minimum value (this is equivalent to Rmax given in JIS B0601). As for 1 time of measuring range, it is desirable from the ability of data not to become a local numeric value easily that it is at least 1mm - 10cm along with a septum crowning. In this invention, this actuation is performed in nine measurement parts, and that average is defined as irregularity.
[0032] Although the irregularity of the shape of a "wave" of the longitudinal direction of the flat surface which constitutes a crowning, and the partial irregularity of the letter of a projection exist in the irregularity of the longitudinal direction of a septum crowning, each of such irregularity causes a cross talk. All are defects although there is a case of the trough which is low with the case of the crest which is higher than average height in the case of-like ["wave"]. If it is the height h2 to a "wave"-like crest crowning, and the height h3 to the bottom of thread section, using the average height of a septum as h1, those differences (h2-h3) will pose a problem and, in the case of the letter of a projection, a difference (h4-h1) with the height h4 of the part which projected from the septum crowning will pose a problem.
[0033] In this invention, although it becomes indispensable requirements in order that being controlled in the range whose irregularity is 0.5-10 micrometers may avoid defective generating of a cross talk etc., the desirable range of number changes with line breadth of a septum crowning.
[0034] Although it is desirable to apply to a high aspect ratio and high definition plasma display with top-line width

of face of 5-80 micrometers of a septum, a pitch [of 100-250 micrometers], and a height of 50-170 micrometers as for the plasma display of this invention, as for the control to the irregularity of a top longitudinal direction, it is desirable to make it severer as the top-line width of face of a septum becomes narrow.
[0035] That is, when the top-line width of face of a septum is 5 micrometers, as for the irregularity of a septum top longitudinal direction, controlling to 3 micrometers or less is desirable, and when septum line breadth is 80 micrometers, irregularity is permitted to 10 micrometers.
[0036] When septum top-line width of face is plotted to a x axis and the irregularity of a septum top longitudinal direction is plotted to the y-axis, the range below the straight line shown with the relational expression of 75y=190+7x is desirable. For example, as for the irregularity of a septum top longitudinal direction, in the case of 40-micrometer septum top-line width of face, controlling to 6.3 micrometers or less is desirable.
[0037] Although it depends for the irregularity of a top longitudinal direction on line breadth, while the septum of this invention is 5-80 micrometers in the pitch of 100-250 micrometers, height of 50-170 micrometers, and line breadth as above-mentioned, and it is highly minute and is the high aspect ratio controlled by 0.5-10 micrometers and the thing which prevents discharge and a cross talk, it is the description that the stimulus value Y in an XYZ color system is 20 or less, and a septum is what contributes to improvement in the contrast of a display.
[0038] Although a septum consists of inorganic materials, such as glass powder and ceramics, it can reflect the light in which the plasma display emitted light in this case as a septum layer is white by the septum, and can raise the brightness of display light. However, when a septum is white, since the outdoor daylight which carried out incidence to the pixel which is not emitting light reflects, contrast falls. Since reflection of outdoor daylight can be controlled by making the color of a septum black, the contrast of a display can be raised.
[0039] The chromaticity coordinate x and y which are called for from the tristimulus value XYZ of the self-luminous color and them are JIS. Z8722 (measuring method of the object color), JIS Z8717 (measuring method of the fluorescence object color), and JIS It can ask by the approach specified to Z8701 (color specification method by the XYZ color system and 10Y10ZX10 color coordinate system).
[0040] Generally as equipment which measures these stimulus values and chromaticity-coordinate values, the color computer by Suga Test Instruments Co., Ltd. is used. The measured value of this invention is obtained using color computer SM-7-CH (optical conditions; 45-degree exposure, 0-degree light-receiving).
[0041] On 80mm angle and the soda glass substrate with a thickness of 1.3mm, the test portion applied each glass paste so that it might become the desiccation thickness of 50 micrometers, and at 570 degrees C, this was calcinated for 30 minutes and it produced it. It measured using this solid film baking sample, using a white plate (the thing of a barium sulfate, X= 91.06, Y= 93.01, and Z= 106.90 being used as a reference standard) as two C light (******) visual field and criteria. In advance of measurement, zero-point doubling was performed for the white plate only to the soda glass substrate in the sample base in piles. A test portion makes a baking sample side the optical direction of radiation, establishes it in the sample base which has the measurement hole of 12mmphi, and put the white plate on the glass substrate side in piles. In this invention, the location of a test portion was changed, measurement of three points was performed, and the average was made into measured value.
[0042] The stimulus value Y needs to be 20 or less, and the upper limit with desirable still more desirable 2-20 is ten or less, and is five or less more preferably. If the stimulus value Y exceeds 20, it will come to wear gray and contrast and color purity will fall. Moreover, x at the time of searching for a chromaticity coordinate and the value of y can raise the color purity of the luminescent color of a plasma display by making it 0.3-0.36 based on a tristimulus value XYZ, respectively.
[0043] Moreover, it is desirable that the reflective OD value of the septum of this invention is 1.3 or more. The optical-density (reflection OD) value of a black part is 1.6 or more still more preferably 1.5 or more more preferably 1.3 or more using the same sample as measuring a stimulus value Y value. When a reflective OD value sets I0 and reflected light reinforcement to I for incident light reinforcement here - It defines as log (I/I0). Macbeth reflection density meter RD-918 which are a densimeter for printing can be used for measurement. Since the same problem as the case where the stimulus value [in / in a reflective OD value / an XYZ color system] Y exceeds 20 arises, it is not desirable at 1.3 or less.
[0044] Septum formation is performed using the glass paste containing glass particles and an organic component. A glass paste takes into consideration the height and burning shrinkage of a septum to form, and is applied on a substrate, and the spreading film of predetermined thickness is constituted. Although based also on the method of application of a glass paste, in order to form the spreading film of predetermined thickness, it may carry out by repeating the spreading process of the case where it can complete at the spreading process of 1 time, and multiple times. When repeating a spreading process and obtaining predetermined thickness, it is also easy to change the property of the glass paste used.
[0045] One of the purposes of this invention is to control the stimulus value Y in the XYZ color system of the septum after calcinating in order to improve the contrast of a display or less to 20, i.e., obtain the black-ized septum. Thus, it considers as the technique of black-izing a septum, and although the case where only the upper part (part) of the case where the whole septum is black-ized, and a septum is black-ized can be considered, the purpose of this invention can be attained by any approach.
[0046] When black-izing the whole septum, it is also possible to use a single glass paste, and it is also possible to form the spreading film which consists of two or more layers using two or more glass pastes with which the configuration of glass particles differs from particle size distribution.
[0047] Although control of the particle size distribution of glass particles and application of control of the heat

characteristic of the glass ingredient used may be applied to the whole spreading film in order to realize regulating the irregularity of the longitudinal direction of the septum crowning which is another configuration of this invention to 0.5-10 micrometers to black-izing and coincidence, it is also applicable only to the spreading film of the upper layer which constitutes a required septum crowning.
[0048] When black-izing only the septum upper part, a septum consists of two-layer at least, the stimulus value Y in the XYZ color system of the septum upper part is 20 or less, and a chromaticity coordinate x and y are 0.3-0.36, respectively, and the irregularity of the longitudinal direction of a septum crowning is 0.5-10 micrometers. That is, since a septum is constituted from at least two layers, the glass paste of a presentation different, respectively is used.
[0049] But the septum which consists of two-layer [of a simple desirable configuration] consists of a part for the black layer the stimulus value Y of 5-50-micrometer thickness which constitutes the upper part indicates 20 or less to be, and a part for the white of 20-150-micrometer thickness in which the lower part is formed, or a transparent layer. By 5 micrometers or less, the film becomes [upside thickness] thin too much, whenever [black] is not enough and the irregularity of a top longitudinal direction becomes coarse too much. Moreover, since it will become difficult to double completely the coefficient of thermal expansion of an up layer and a lower layer and an open circuit (cut) of a septum and crack initiation will arise in the cooling process after baking if it exceeds 50 micrometers, it is not desirable.
[0050] Although it is also possible to plurality-ize further the layer which constitutes the upper part and the lower part, as for the thickness of a upside black layer, it is desirable that it is the range of 5-50 micrometers.
[0051] Since the septum of such a configuration demonstrates the effectiveness of improving the contrast of a display, in the black layer of the septum upper part, a lower white septum reflects luminescence from a fluorescent substance layer and it contributes to improvement in brightness, it enables brightness to, obtain the good plasma display of contrast high moreover.
[0052] After the septum of a plasma display forms a septum pattern, it is manufactured by calcinating. Although formation of a septum pattern is performed with screen printing, the sandblasting method, or photosensitive mull technique, production of the desirable septum of this invention is not limited to a pattern formation method. However, it is desirable to use photosensitive mull technique as an approach the septum of a high aspect ratio and a high definition and a rectangle, or a trapezoid configuration can produce with sufficient repeatability, and can respond also to enlargement of a display.
[0053] Since the septum for plasma displays is formed on a glass substrate, the glass ingredient used as the component of a glass paste needs to fuse at temperature lower than the glass transition point of a glass substrate. As a glass ingredient which has such the temperature characteristic, what contains a lead oxide and the bisumuth oxide 30% of the weight or more has been used conventionally.
[0054] As for the septum of this invention, it is desirable that a glass transition point consists of glass ingredients 450-550 degrees C and whose softening temperatures are 500-600 degrees C. As a glass ingredient which has such a heat characteristic, the glass ingredient of the presentation shown below in the account of an oxide conversion chart can be mentioned.
Lithium oxide 3 - 15-% of the weight oxidation silicon 10 - 30-% of the weight oxidation boron 20 - 40-% of the weight barium oxide 2 - 15-% of the weight aluminum oxide By using the glass ingredient which contains lithium oxide three to 15% of the weight in this way ten to 25% of the weight, control of softening temperature and a coefficient of thermal expansion not only becomes easy, but since the average refractive index of glass can be made low, when using as a photosensitive paste, it becomes easy to make small a refractive-index difference with a photosensitive organic component.
[0055] Moreover, the addition of an alkali-metal oxide has 15 or less desirable % of the weight, and it is 10 or less % of the weight more preferably. If it exceeds 15 % of the weight, alkali metal evaporates at the time of discharge, the coefficient of thermal expansion of glass becomes high too much, adjustment with a glass substrate becomes [the problem on which a discharge property deteriorates arises, or] difficult, and it is not desirable.
[0056] In the above-mentioned presentation, although sodium oxide and potassium oxide may be used instead of lithium oxide, lithium oxide is desirable at a point with little evaporation at the time of the pot life of a paste, a heat characteristic, a discharge property, and sintering. Since there is an advantage which can perform comparatively little addition or control of a refractive index when potassium oxide is used, addition of lithium oxide and potassium oxide is effective also in alkali-metal oxide.
[0057] Moreover, it is desirable to blend oxidation silicon in 10 - 30% of the weight of the range, when it is less than 10 % of the weight, compactness, and the reinforcement and stability of a glass layer fall, and a coefficient of thermal expansion separates from a desired value, and a mismatch with a glass substrate tends to happen. Moreover, the problem to which softening temperature will become high too much if it exceeds 30 % of the weight, and baking to a glass substrate becomes difficult arises.
[0058] As for boron oxide, it is desirable to blend in 20 - 40% of the weight of the range. If it exceeds 40 % of the weight, the stability of glass will fall. By fusing glass powder at the temperature near 800-1200 degree C, and blending boron oxide, even when there is much oxidation silicon, boron oxide can be burned, can control temperature in the range of 530-580 degrees C, and does not spoil the electrical and electric equipment, a machine, and thermal properties, such as the compactness of electric insulation, reinforcement, a coefficient of thermal expansion, and an insulating layer.
[0059] As for the barium oxide, it is desirable to blend in 2 - 15% of the weight of the range. At less than 2 % of the

weight, it becomes difficult to control glass baking temperature and electric insulation. Moreover, if it exceeds 15 % of the weight, the stability and compactness of a glass layer will fall.
[0060] As for an aluminum oxide, it is desirable to blend in 10 - 25% of the weight of the range. An aluminum oxide raises the point [distortion] of glass, or is added for stabilization of a glass presentation, or pot-life extension of a paste. The reinforcement of a glass layer falls at less than 10 % of the weight. If it exceeds 25 % of the weight, the heat-resistant temperature of glass will become high too much, and baking will become difficult on a glass substrate. Moreover, a precise insulating layer becomes that it is hard to be obtained at the temperature of 600 degrees C or less.
[0061] A zinc oxide, a calcium oxide, or a magnesium oxide may be blended in the account of an oxide conversion chart other than these components.
[0062] In this case, as for a zinc oxide, it is desirable to blend in 2 - 15% of the weight of the range. At less than 2 % of the weight, there is no effectiveness in the improvement in compactness of an insulating layer. If it exceeds 15 % of the weight, since the temperature carried out by the ability being burned on a glass substrate will become low too much, it will become impossible to control and insulation resistance will become low, it is not desirable.
[0063] As for a calcium oxide, it is desirable to blend in 2 - 13% of the weight of the range. While making glass easy to fuse, it is added although a coefficient of thermal expansion is controlled. If fewer than 2 % of the weight, a point [distortion] will become low too much. It can be burned if it exceeds 13 % of the weight, and temperature becomes high too much and is not desirable.
[0064] As for a magnesium oxide, it is desirable to blend in 1 - 15% of the weight of the range. A magnesium oxide is added in order to control a coefficient of thermal expansion, while making glass easy to fuse. If it exceeds 15 % of the weight, it will be easy to devitrify glass and it will not be easy to become.
[0065] Moreover, although titanium oxide, a zirconium dioxide, etc. can be contained in a glass ingredient, as for the amount, it is desirable that it is less than 5 % of the weight. A zirconium dioxide has effectiveness in controlling the softening temperature, the glass transition point, and electric insulation of glass.
[0066] In addition to 50 - 90 % of the weight of glass ingredients which have the above properties, as a non-subtlety particle used for a glass paste, the softening temperature used as a filler can add still more preferably 550-1200 degrees C of 650-800-degree C high-melting glass and ceramics ten to 50% of the weight. By addition of these filler components, contraction at the time of baking becomes small, and the configuration holdout and precision of a septum pattern improve. Furthermore, these filler addition is desirable when maintaining the reinforcement of the obtained septum. There is little effectiveness that a filler makes burning shrinkage low or controls a coefficient of thermal expansion by less than 10 % of the weight. Moreover, when a filler content exceeds 50 % of the weight, it becomes what is inferior in the septum after baking in respect of compactness, and the reinforcement of a septum falls, a septum may separate or the defect of dropping out may occur. Furthermore, it becomes the cause which adsorption and the organic component of minute amount moisture remain, and causes the fall of a discharge property into a septum.
[0067] the filler used by this invention was chosen from the group which consists of titanium oxide, an alumina, barium titanate, a zirconia, cordierite, a mullite, and high-melting glass powder — it is a kind at least. What includes the presentation of the following [the account of an oxide conversion chart] as high-melting glass powder is used preferably.
Oxidation silicon : 15 - 50-% of the weight boron oxide : 5 - 20-% of the weight aluminum oxide : 15 - 50-% of the weight barium oxide : 2 - 10 % of the weight.
[0068] As high-melting glass powder, the glass powder which contains oxidation silicon and an aluminum oxide 15% of the weight or more is desirable, and it is effective that these content sum totals are 50 % of the weight or more among glass powder in order to give a required heat characteristic.
[0069] In a photosensitive paste, in case high-melting glass powder is used as a filler, if a refractive-index difference with a glass ingredient is large, adjustment with the average refractive index of an organic component will become difficult, and pattern formation nature will worsen. As for the difference of the refractive index of high-melting glass powder, and the refractive index of the glass ingredient of the low melting point, it is desirable that it is within the limits of 0.05 [**], and taking into consideration in presentation combination is important.
[0070] As for the septum of this invention, it is desirable to contain in total the black pigment which consists of the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, or Co three to 20% of the weight. the component added in order to make into less than [of a request of a septum / stimulus value Y20] the metal or oxide which presents such black — it is — as the constituent of the glass particles of septum formation — a glass ingredient, a filler, etc. — the same — a powder condition — mixing — you may use — moreover, the time of production of a glass ingredient — coincidence — fusing — homogeneity and homogeneous melting — you may use as a mixture.
[0071] A white septum is obtained when a transparent septum is formed when the glass paste used for septum formation contains only the glass ingredient containing lithium oxide of 450-550 degrees C of glass transition points, and 500-600 degrees C of softening temperatures, and it contains a glass ingredient and a filler component. If further above-mentioned metals or those oxides are added, the black-ized septum can be obtained.
[0072] The particle size of the glass ingredient used in septum formation of this invention is chosen in consideration of the smooth nature of the line breadth of a septum, height, or a septum crowning which it is going to produce. When a histogram shows the particle size distribution of a glass ingredient by making an axis of abscissa into particle size (micrometer) wholeheartedly about the grain size of a glass ingredient, and its distribution as a result of examination, having made the axis of ordinate as frequency(%), restoration nature has that good in which particle

size distribution have not mere normal distribution but at least two or more peaks, and spreading nature is excellent. When it furthermore considers as a photosensitive paste, light scattering in the film is controlled, total light transmission is high, and it has found out excelling in pattern formation nature.
[0073] A glass ingredient is produced through processes, such as adjustment of a preparation raw material, melting, grinding, classification, and desiccation. The particle size distribution are controlled in the process of grinding and a classification. The approach of a ball mill, a jet mill, etc. is used for grinding. Moreover, a classification is performed by dry classification, such as sieving and an air-current type classification. The particle size distribution of the obtained particle can be measured by the laser diffraction scattering method. For example, the Measuring condition at the time of using micro truck company make and particle-size-distribution meter HRA9320-X100 is as follows.
The amount of samples : 1g distribution conditions : It is ultrasonic distribution for 1 - 1.5 minutes in purified water. When it is hard to distribute, it carries out in 0.2% hexametaphosphoric acid sodium water solution.
Particle refractive index: Change according to the class of glass (in the case of a lithium system 1.6).
Solvent refractive index: 1.33 measurement sizes : 2 times.
[0074] Generally, the adhesion force of a particle is dependent on surface area. Since it is easy to condense the thing which has a small particle size, a desired pattern property is not acquired that an opening can tend to do it when homogeneity is hard to be distributed and the particle with a small particle size forms the spreading film during a paste. On the other hand, if particle size is too large, depending on burning temperature, irregularity arises in the crowning of the septum after baking, a clearance will be made between front plates at the time of sealing, and a cross talk will arise. While the restoration nature to a paste is good and a paste with coherent [little] is obtained, the particle size of a glass ingredient without the irregularity of the septum crowning after baking or the problem of a foreign matter is 1.5-7 micrometers, and the maximum particle diameter is 7-40 micrometers. If mean particle diameter is less than 1.5 micrometers, coherent [powdered] will be large and restoration nature, spreading nature, and pattern formation nature will worsen. Moreover, if larger than 7 micrometers, since the irregularity of the septum crowning after baking becomes large, the problem in which a cross talk occurs will arise. 1.5-7 micrometers of mean particle diameter are 2-5 micrometers more preferably. As for especially the mean particle diameter of the glass ingredient in the case of using for up formation of the septum of two-layer formation at least, it is desirable to make it 4 micrometers or less.
[0075] If restoration nature, spreading nature, and pattern formation nature worsen and the maximum particle diameter exceeds 40 micrometers in less than 7 micrometers, the problem on which a foreign matter remains in the irregularity of the septum crowning after baking or discharge space will arise. 7-40 micrometers, since that it is 10-30 micrometers has the restoration nature to a paste, spreading nature, and good pattern formation nature, the maximum particle diameter has it. [more preferably desirable] However, as for the maximum particle diameter of the glass ingredient in the case of being used for up formation of the septum of two-layer formation at least, holding to 10 micrometers or less is desirable.
[0076] It becomes desirable conditions to make low softening temperature of to control the mean particle diameter and the maximum grain size of a glass ingredient and a glass ingredient as a technical problem by the side of the glass ingredient leading to [of the glass paste for controlling the irregularity of the longitudinal direction of a septum crowning to 0.5-10 micrometers] presentation-.
[0077] That is, the mean particle diameter of the glass powder preferably applied to the glass paste for septum formation is 1.5-7 micrometers, and is 2-5 micrometers more preferably. If distribution of the particle size of glass powder is taken into consideration in order not to make a septum crowning generate the irregularity of 10 micrometers or more, the mean particle diameter of the glass ingredient added to the glass paste which forms the septum upper part at least will have good 4 micrometers or less. Moreover, as for the maximum particle diameter, it is desirable that it is 10 micrometers or less.
[0078] Thus, these low-melting-glass ingredients depend on it not being necessarily it to control the particle size of the glass ingredient contained in the spreading film of the glass paste which forms a septum crowning what all fuse completely at a baking process. Although it is thought that it passes through the process which fuses a glass ingredient while the organic component of a glass paste vaporizes in a pyrolysis etc. in a baking process, is welded and is unified mutually, welding may be carried out without a glass ingredient with a big particle size fusing completely, when a glass ingredient with big mean particle diameter is used, when this occurs on a front face, sticking becomes poor, and it becomes the cause of concavo-convex generating.
[0079] The more desirable thing for which 10-30 degrees C is made low is still more desirable than the softening temperature of the glass ingredient which the glass paste which forms the septum lower part for the softening temperature of the glass ingredient contained in the glass paste which forms a septum crowning in this invention contains 10-50 degrees C. Although the heat characteristic of the glass ingredient preferably used for septum formation is the range whose glass transition point is 450-550 degrees C and is the range whose softening temperature is 500-600 degrees C, it is desirable than the glass ingredient of the paste which forms the septum lower part within the limits of these to set up low the softening temperature of the glass ingredient which the glass paste of up layer spreading which forms especially a septum crowning contains, and to prevent lump generating by the lack of fusion in the above baking processes. Although setup of the temperature in a baking process is important conditions, it becomes the lack of melting by few temperature gradients, or defects, like a septum configuration carries out sagging **** contraction too much past [baking] occur. Usually, it is set as temperature higher 30-70 degrees C than the softening temperature of the glass ingredient contained in a paste, and calcinates. The glass ingredient of softening temperature low for formation of a septum crowning can be used, a difference with softening

temperature can be enlarged in the set-up burning temperature, perfect melting can be made to be able to perform, and a smooth crowning can be formed. Of course, a temperature setup which minded enough is required for generating of sagging.
[0080] Control of the heat characteristic of the glass powder which constitutes a glass paste is possible by rationalizing a class, an addition, etc. of a presentation component, and can be adjusted within the limits of a respectively desirable addition.
[0081] The conditions of making low softening temperature of the glass ingredient which the glass paste which forms a septum crowning contains can heighten effectiveness by using together with the conditions which control the mean particle diameter of glass powder to 4 micrometers or less.
[0082] There are the shape of a stripe and a grid configuration as septum configuration. The contrast of this invention is applied to any septum of a type in the plasma display which is good and does not generate the cross talk at the time of discharge. When it has a stripe-like septum especially, it has effect for the display engine performance of a plasma display with serious extent of the irregularity of the longitudinal direction of a septum crowning.
[0083] The stimulus value Y in the XYZ color system of the septum of this invention is 20 or less, and the plasma display which has the septum whose irregularity of the longitudinal direction of a septum crowning is 0.5-10 micrometers is manufactured using the glass paste which consists of glass particles which have an above-mentioned heat characteristic and particle size distribution, and an organic component. Moreover, it is characterized by containing preferably the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, or Co three to 20% of the weight in total at the glass particles. Although it may mix and use with a glass ingredient and a filler component and glass particles may be constituted, in case a glass ingredient is formed, melting mixing of these metals or those oxides can be carried out, and they can also be used, as already stated.
[0084] The septum which presents the black of this invention is obtained by controlling strictly the configuration, the particle size distribution and the content of the glass particles under paste for septa, the class, addition and the addition approach of a black pigment, a class, a content of the organic component contained in a paste, etc. with sufficient balance. Since the vaporization (debinder nature) of the organic component at the time of baking and burning shrinkage have delicate effect, it is necessary to choose glass particles, a black pigment, and an organic component, and to choose baking conditions.
[0085] After the description of this invention presenting white or gray in the phase of the paste which makes a constituent the glass particles and them containing a black pigment component and calcinating a septum pattern, the septum in which whenever [sufficient / black] is shown is obtained. Therefore, in a spreading film phase, even if it is the photosensitive paste using these glass particles as a component, since it is white or gray, it is possible to make the ultraviolet rays for patternizing fully penetrate, and photo-curing can be carried out to the spreading film lower part.
[0086] This invention is based on having found out the black pigment black-ized after baking. The black pigment which has such a description is the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co. About the device black-ized after baking, it is not clear. Even if some kinds of these metals or oxides contain in glass particles, in the state of a particle, light is scattered about for powder and white or gray is presented. However, when it is calcinated and a precise septum is formed, what absorbs and black-izes light is presumed.
[0087] In order to make it act as a black pigment, it can use in the form where above-mentioned metals or those oxides are mixed with the mixture of glass powder and a filler. Furthermore, the powder which added the black pigment component, and fused and produced it in the production process of glass powder can also be used. In the case of the powder which carried out melting mixing, control of the particle size distribution of glass particles becomes easy. Moreover, the addition of a black pigment is little compared with the case of simple mixing, and since a black septum without homogeneous nonuniformity is obtained, it is desirable.
[0088] Although these simple metals mixed and melting mixed or the oxide of those may use not one kind but some kinds, since it is excellent in controlling whenever [of functional maintenance of a paste, and the obtained septum / black] that it is 3 - 20 % of the weight in total, it is desirable. It is 5 - 15 % of the weight more preferably. At less than 3 % of the weight, whenever [of a septum / black] becomes weak, it is visible to gray and there is no improvement effectiveness in contrast. Moreover, if [than 20 % of the weight] more, the softening temperature of glass will go up or it will become difficult to adjust a coefficient of thermal expansion with a glass substrate.
[0089] The septum made into the purpose of this invention can be produced by various technique. It is applicable combining all the approaches by which the means (black-izing) of the formation of septum black for making the stimulus value Y in an XYZ color system or less into 20 and a means (smoothing) to control the irregularity of the longitudinal direction of a septum crowning to 0.5-10 micrometers are realized.
[0090] Using the single paste with which are satisfied of the conditions of black-izing and smoothing, the whole septum is black and can form a septum with a smooth septum crowning. In this case, although the whole septum is black, it is also possible to apply the glass-particles conditions which make a septum crowning smooth only to the paste which forms a septum crowning.
[0091] Thus, as a means to perform grant and separation of a function efficiently, consisting of two-layer at least is desirable, and it is desirable to impose the function of black-izing and the function to control the irregularity of the longitudinal direction of a septum crowning on the layer of the septum upper part with a thickness of 5-50 micrometers which forms especially a crowning.
[0092] That is, the glass paste which forms the septum lower part which is a 20-150-micrometer layer consists of

the glass particles and the organic component which consist of the glass ingredient or glass ingredient which has the grain size which gives the property excellent in an above-mentioned desirable heat characteristic and restoration nature, spreading nature, and pattern formation nature, and its distribution, and a filler, and is applied by known technique. This performs pattern formation and baking with the layer of the septum upper part applied on it, and forms transparence or a white septum layer.
[0093] The black part of the septum upper part is 5-50 micrometers, and the glass paste which forms this layer contains the glass particles which contain the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, or Co three to 20% of the weight in total. Since the black part which furthermore forms this upper part functions as a layer which controls the irregularity of the longitudinal direction of a septum crowning to 0.5-10 micrometers, it is important for it to adjust the mean particle diameter and the maximum particle diameter of the glass ingredient to be used to the aforementioned desirable range.
[0094] Furthermore, in order to control the irregularity of the longitudinal direction of a septum crowning in the desirable range, softening temperature of the glass ingredient contained in the glass paste which forms the upper part is characterized by being [10-50 degrees C / softening temperature / of the glass ingredient which constitutes the lower part] more preferably low 10-30 degrees C.
[0095] When forming a septum pattern with screen printing, the glass paste containing the glass ingredient which forms the lower part, and a filler is applied and dried at 20-150 micrometers. The glass ingredient which moreover controlled grain size and fell softening temperature further, A filler, and Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, After applying and drying the glass paste which contains the metals or those oxides of Bi and Co three to 20% of the weight in total at the thickness of 5-50 micrometers, the stimulus value Y in a desired XYZ color system by calcinating or less by 20 It is possible to obtain the septum whose irregularity of a septum longitudinal direction is 0.5-10 micrometers. However, manufacture of a high aspect ratio and a high definition septum has the problem of being difficult, from the problem of a precision peculiar to screen printing.
[0096] The solid film which consists of two-layer is formed using screen printing or the known film formation applying method, and it can apply also to the approach of carrying out pattern formation by the sandblasting method. Furthermore, the stimulus value [in / it consists of two-layer at least, and / in the layer of the septum upper part / an XYZ color system] Y of this invention can form the septum whose irregularity of the longitudinal direction of a septum crowning is 0.5-10 micrometers or less by 20 with photosensitive mull technique.
[0097] In the photosensitive paste used by this invention, the thing of the optical insolubilization mold with which a desirable photosensitive organic component consists of a photosensitive monomer, photosensitive oligomer or a polymer, and a photopolymerization initiator fundamentally is used. The glass particles used as a septum component can blend the glass ingredient which divided the presentation rate proportionally in the range which added and mentioned already problems, such as the adjustment of the average refractive index for raising the light transmission other than the requirements for restoration nature, and the requirements for spreading nature, to such a photosensitive organic component. In this case, the whole septum may be constituted using the photosensitive paste containing a black pigment, a glass ingredient and the photosensitive paste containing a filler may be applied to the layer of the septum lower part, and the approach of applying the photosensitive paste which contains the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, or Co three to 20% of the weight in total may be used for the upper part.
[0098] 1 simple lamination -- or at least, by the same technique, it can pattern-expose, the photosensitive paste coating film of a two-layer configuration can be developed, a septum pattern can be formed, this can be calcinated, and a desired septum can be obtained. In this phase, since the photosensitive paste which contains the metals or those oxides of Ru, Mn, nickel, Cr, Fe, Ti, Cu, Pb, Bi, and Co three to 20% of the weight in total is extent which wears gray and it has ultraviolet-rays permeability considerably, it has sufficient sensibility to function as a photosensitive paste. By passing through a baking process, the stimulus value Y amounts to 20 or less, and wears black.
[0099] Furthermore, while advancing melting of the glass ingredient of an up layer more completely at a baking process, being able to lessen surface irregularity more and contrast's improving by black-ization by using the lower glass ingredient of softening temperature for the glass paste which constitutes the septum upper part from a lower glass ingredient, the plasma display in which the display without a cross talk is possible can be manufactured.
[0100]
[Example] An example is used for below and this invention is concretely explained to it. However, this invention is not limited to these. In addition, especially concentration (%) is weight % unless it refuses.
[0101] (Example 1) As a glass ingredient (A), the presentation with the account of an oxide conversion chart used the powder of 6.7% of lithium oxide, 22% of oxidization silicon, 32% of boron oxide, 3.9% of barium oxide, 19% of aluminum oxides, 5.5% of zinc oxides, 5.5% of magnesium oxides, and 4.1% of calcium oxides. This glass powder has the property with the average refractive index 1.58, 497 degrees C of glass transition points, the softening temperature of 530 degrees C, the 50 volume % particle diameter (mean particle diameter and D50 are called) of 2.2 micrometers, the 10 volume % particle diameter (D10 is called) of 0.8 micrometers, a 90 volume % particle diameter [of 6.8 micrometers] (D90 is called), and a maximum particle diameter of 22 micrometers. Moreover, specific surface area is 2.13m2/g, and is glass powder with a tap density of 0.78g [/cc].
[0102] Still more nearly independently, although it was the same presentation as the above, D50 prepared 2.7 micrometers and the glass ingredient (B) 7.8 micrometers and whose maximum particle diameter 0.9 micrometers and D90 are 4.6 micrometers, specific-surface-area 1.93m2/g, and the tap density of 0.85g/cc for D10.

[0103] The glass impalpable powder which consists of glass powder (A)75% and 25% (Ishihara Sangyo [Kaisha, Ltd.] make: TR-50, mean particle diameter of 1.6 micrometers) of titanium oxide was used for the paste which forms the lower part of a septum. And the glass impalpable powder which contains 10% for glass (ingredient B) 90%, the nickel oxide used as a black pigment, and cobalt oxide (it is 1:3 at a weight ratio) in total was used for the paste which forms the upper part of a septum.
[0104] The polymer solution of 4% of concentration which dissolved ethyl cellulose in the terpineol was made to distribute the above-mentioned glass powder mixture, respectively, and the glass paste for the object for the septum lower parts and up formation was produced.
[0105] The screen-stencil version which has shape of stripe and pitch 230micrometer and a pattern with a line breadth of 60 micrometers was produced, spreading and desiccation were repeated using this, the laminating of the glass paste for septum lower formation was first carried out to the desiccation thickness of 120 micrometers, and the laminating of the paste for septum up formation was carried out to the desiccation thickness of 30 micrometers on it after that. This pattern-like septum was calcinated for 30 minutes at 570 degrees C among air, and the septum with a thickness of 110 micrometers was obtained.
[0106] Although the lower part of this septum was presenting white, the up layer showed black and the stimulus value Y in an XYZ color system was 11. the chromaticity coordinate x and y which were calculated from the value of X, Y, and Z -- respectively -- 0. -- it was 31 and 0.32. The reflective OD value was 1.4.
[0107] Furthermore, the line breadth of the obtained septum was 35 micrometers, and when it computed the average of 3mm of measuring range, and nine counts for the irregularity of the longitudinal direction of this septum crowning with the sensing-pin-type surface roughness plan (Kosaka Laboratory SE 3300), it was 3.5 micrometers.
[0108] Next, the fluorescent substance was applied between adjacent septa. The fluorescent substance paste was produced in red (Y, Gd), having used [BO3:Eu / Zn2SiO4:Mn / these fluorescent substance powder] the terpineol as the solvent for ethyl cellulose green at binder resin using the fluorescent substance of MgAl (Ba, Eu) 10O17 blue. Spreading of a fluorescent substance was formed by the dispenser method which carries out the regurgitation of the fluorescent substance paste from the nozzle tip in which 256 holes (aperture: 130 micrometers) were formed. After applying a fluorescent substance so that it may become the thickness after baking of 25 micrometers on a septum side face and it may become the thickness after baking of 25 micrometers on a dielectric, it performed baking for 10 minutes at 500 degrees C.
[0109] Furthermore, the front substrate and tooth-back substrate which were produced were sealed using sealing glass, and Ne gas of Xe5% content was enclosed so that it might become 66500Pa of internal gas pressure. Furthermore, the drive circuit was mounted and PDP was produced.
[0110] The brightness at the time of complete lighting was measured using photometry opportunity MCP-200 by the Otsuka electronic company. Brightness was 400 cd/m2. moreover, the photometry machine by the Otsuka electronic company -- the contrast ratio measured by MCPD-200 was 280:1.
[0111] (Example 2) Compared with the glass ingredient (A) of an example 1, the glass powder which has the following presentation was used as a component of the paste for septum up formation as a low glass ingredient (C) of softening temperature. That is, it is the glass powder which consists of a presentation of 8.6% of lithium oxide, 20.1% of oxidization silicon, 31% of boron oxide, 3.8% of barium oxide, 20.6% of aluminum oxides, 2.1% of zinc oxides, 5.9% of magnesium oxides, and 4.2% of calcium oxides.
[0112] This glass ingredient has the property of the average refractive index 1.57, 472 degrees C of glass transition points, and 515 degrees C of softening temperatures. Moreover, 2.0 micrometers and D10 have 1.0 micrometers, and, as for glass powder, D50 has 5.0-micrometer, maximum particle diameter [of 10 micrometers], and specific-surface-area 1.9m2/g, and a property with a tap density of 0.80g [/cc], as for D90.
[0113] What consists of high-melting glass 20% of a presentation indicated below to be glass (ingredient A) 80% as glass powder mixture which forms the septum lower part was used.
[0114] The presentation of oxide conversion of high-melting glass is a presentation of 38.2% of oxidization silicon, 9.2% of boron oxide, 5.1% of barium oxide, 34.5% of aluminum oxides, 4.8% of magnesium oxide, 4.4% of calcium oxides, and 2.1% of titanium oxide. The glass transition point of this high-melting glass was 652 degrees C, softening temperature was 746 degrees C, and the average refractive index 1.58 and D50 were the spherical powder 1.0 micrometers and whose D90 2.1 micrometers and D10 are 3.4-micrometer, maximum particle diameter [of 7.8 micrometers], and specific-surface-area 3.32m2/g, and the tap density of 1.1g/cc.
[0115] Moreover, the impalpable powder which added 4% of iron sesquioxides, 3% of cobalt oxide, and 3% of chrome oxide to glass (ingredient C) 90%, and was mixed as glass powder mixture which forms the septum upper part was used.
[0116] In this example, in order to form a septum pattern with photosensitive mull technique, the photopolymerization initiator (IC-369) 7.2 weight section, the polymerization inhibitor (HQME) 0.5 weight section, the dispersant (NOPUKO sparse 092, Sannopuko make) 0.5 weight section, and the ultraviolet ray absorbent 1.7 weight section were added to the paste which mixed the above-mentioned glass powder mixture 70 weight section, the photosensitive polymer (X-4007) 15 weight section, and the photosensitive monomer (MGP400) 15 weight section. As an ultraviolet ray absorbent, the 1.2 weight section and the Uvinul3039 (Basf Japan make) 0.5 weight section were used for 1, 2, and 3-benzotriazol. Moreover, gamma-butyrolactone was used as an organic solvent which adjusts the viscosity of a paste.
[0117] Thus, the photosensitive paste containing the adjusted glass ingredient (A) was applied to homogeneity with screen printing, and the spreading film with a desiccation thickness of 160 micrometers was obtained. In order to

avoid generating of the pinhole of the spreading film etc., spreading and desiccation were repeated several times and performed. after performing intermediate desiccation every [during 10 minutes] at 80 degrees C and reaching predetermined spreading thickness, it dried for 90 minutes at 80 degrees C. Subsequently, the laminating of the spreading film with a desiccation thickness of 30 micrometers was carried out for the photosensitive paste containing a glass ingredient (C) for septum up formation.
[0118] One pro squeak tee exposure (spacing of 100 micrometers of a spreading film front face and a photo mask) was performed to this spreading film by which the laminating was carried out through the photo mask (stripe-like pattern and pitch 130micrometer, line breadth of 20 micrometers). Light exposure was 900 mJ/cm2 in the ultrahigh pressure mercury lamp of the output of 15 mW/cm2. Then, by pouring in a shower 0.3% water solution of the monoethanolamine held at 35 degrees C for 180 seconds, it developed negatives and rinsed and the septum pattern was formed on the glass substrate. Subsequently, baking processing was performed for 15 minutes at 575 degrees C among air, and height [of 100 micrometers] and pitch 130micrometer and a septum with a line breadth of 25 micrometers were formed. When the irregularity of the longitudinal direction of the obtained septum crowning was measured, it was a maximum of 2.5 micrometers.
[0119] furthermore, the stimulus value Y in the XYZ color system of the obtained septum -- 5 -- it is -- a chromaticity coordinate x and y -- respectively -- 0. -- it was 32 and 0.34. The reflective OD value was 1.5.
[0120] The obtained lower part was white, the cross talk by malfunction was not observed by the plasma display panel constituted using the substrate which has the septum by which the upper part presents black, but the good display of contrast was obtained. The brightness of a panel was 400 cd/m2. the photometry machine by the Otsuka electronic company -- the contrast ratio measured by MCPD-200 was 200:1.
[0121] (Example 3) The photosensitive glass paste containing the glass ingredient (A) used in the example 2 was used for formation of the septum lower part, for the paste which forms the septum upper part, the glass [with small and D50] ingredient (D) with softening temperature lower than a glass ingredient (A) was used, and the example 2 was repeated.
[0122] Although the presentation of a glass ingredient (D) is the same as that of a glass ingredient (C), for D50, 1.6 micrometers and D10 are [3.5 micrometers and the maximum particle diameter of 0.7 micrometers and D90] 9.3 micrometers, and specific surface area is 0.76g/cc in 3.44m2/g and tap density.
[0123] After forming a septum pattern like an example 2, the septum crowning calcinated and obtained had high smooth nature, and the irregularity of the longitudinal direction was 1.9 micrometers by the average. the stimulus value Y in the XYZ color system of a septum -- 13 -- it is -- and a chromaticity coordinate x and y -- respectively -- 0. -- it was 32 and 0.33. The reflective OD value was 1.4. Moreover, the plasma DIPU lei panel was produced on the same conditions as an example 1. The brightness of a panel was 400 cd/m2 and the contrast ratio was 250:1.
[0124] (Example 4) In the example 2, cordierite (the mean particle diameter of 2.3 micrometers, refractive index 1.56) was used instead of high-melting glass as a filler component.
[0125] the stimulus value [in / the irregularity of the longitudinal direction of a septum crowning is the same as that of the case of an example 2, and / the XYZ color system of a septum] Y -- 15 -- it is -- a chromaticity coordinate x and y -- respectively -- 0. -- it was 33 and 0.34. The reflective OD value was 1.3. The plasma DIPU lei panel was produced on the same conditions as an example 1. The brightness of a panel was 360 cd/m2 and the contrast ratio was 250:1.
[0126] (Example 5) As glass particles, what mixed 4% of iron sesquioxides which serve as alumina (mean-particle-diameter [of 2.5 micrometers], refractive index 1.77) 20% and a black pigment as a filler component, 3% of cobalt oxide, and 3% of chrome oxide was used glass (ingredient B) 70%.
[0127] The photosensitive paste was produced by the same presentation combination as what was shown in the example 2 using these glass particles, and the spreading film with a desiccation thickness of 130 micrometers was obtained by the same approach. Furthermore, by the approach indicated in the example 2, exposure, development, and baking were performed and the septum by which the whole with a height [of 100 micrometers] and a line breadth of 25 micrometers presents black was formed. The irregularity of the longitudinal direction of this septum crowning was a maximum of 4.5 micrometers. moreover, the stimulus value Y in the XYZ color system of a septum -- 15 -- it is -- a chromaticity coordinate x and y -- respectively -- 0. -- it was 35 and 0.36. The reflective OD value was 1.4. The plasma display panel was produced on the same conditions as an example 1. Brightness was 410 cd/m2 and the contrast ratio was 280:1.
[0128] (Example 6) When it was combination production of a glass ingredient, nickel oxide and cobalt oxide were made for the content in a glass ingredient to become 7% to the presentation of a glass ingredient (A) as a weight ratio 1:4 by oxide conversion. That is, the glass ingredient which carried out melting mixing of the black pigment component at homogeneity was produced. The mean diameter and the maximum particle diameter of this glass ingredient were controlled on the same level as a glass ingredient (B). Cordierite 15% was mixed with 85% of this glass ingredient as a filler component, and it considered as glass particles.
[0129] Using these glass particles, the photosensitive glass paste was adjusted by the same combination as an example 2, and the septum pattern was produced like the example 5. The septum which the whole black-ized was obtained and the stimulus value Y in an XYZ color system was 16. The average of the irregularity of the longitudinal direction of a septum crowning was 3.8 micrometers. The reflective OD value was 1.3. Furthermore, the plasma display panel was produced on the same conditions as an example 1. Brightness was 400 cd/m2 and the contrast ratio was 250:1.
[0130] (Example 7) The glass ingredient which carried out melting mixing of the black pigment component used in

the example 6 was blended with the photosensitive paste for septum up formation in an example 2, and the example 2 was repeated. The upper part was black and the septum whose lower part is white was obtained. The stimulus value Y in the XYZ color system of a septum was 4.0. The average of the irregularity of the longitudinal direction of a septum crowning was 4.1 micrometers. The reflective OD value was 1.6. The plasma display panel was produced on the same conditions as an example 1. Brightness was 370 cd/m2 and the contrast ratio was 400:1.
[0131] (Example 8) It was made for a ruthenium oxide content to become 6% to the presentation of a glass ingredient (A) in the case of combination production of a glass ingredient. Next, the glass ingredient which carried out melting mixing of the black pigment component at homogeneity was produced. Using this glass ingredient, it blended with the photosensitive paste for septum up formation in an example 2, and the example 2 was repeated. The upper part was black and the septum whose lower part is white was obtained. The stimulus value Y in the XYZ color system of a septum was 5.0. Moreover, the average of the irregularity of the longitudinal direction of a septum crowning was 3.5 micrometers. The reflective OD value was 1.5. The plasma display panel was produced on the same conditions as an example 1. Brightness was 400 cd/m2 and the contrast ratio was 350:1.
[0132] (Example 9) When it was combination production of a glass ingredient, manganese oxide and cobalt oxide were blended with the presentation of a glass ingredient (A) so that the content in a glass ingredient might become as a weight ratio 2:2 by oxide conversion at 7%. That is, the glass ingredient which carried out melting mixing of the black pigment component at homogeneity was produced. The mean diameter and the maximum particle diameter of this glass ingredient were controlled on the same level as a glass ingredient (B). The glass ingredient was blended with the photosensitive paste for septum up formation in an example 2, and the example 2 was repeated. The upper part was black and the septum whose lower part is white was obtained. The stimulus value Y in the XYZ color system of a septum was 3.5. Moreover, the average of the irregularity of the longitudinal direction of a septum crowning was 4.3 micrometers. The reflective OD value was 1.6. The plasma display panel was produced on the same conditions as an example 1. Brightness was 380 cd/m2 and the contrast ratio was 250:1.
[0133] The semantics of the abridged notation used in the above-mentioned example is as follows, respectively.
Photosensitive polymer of the weight average molecular weight 43 and 000 and the acid number 95 to which the addition reaction of the 0.4Eq glycidyl methacrylate was carried out to the copolymer which consists of a methacrylic acid, 30% methyl methacrylate, and 30% styrene X-4007:40%.
MGP400:X2 H-CH(CH3)-CH2-(OCH2CH (CH3)) n-NX2 -- here, X=-CH2CH(OH)-CH2 O-CO-C(CH3) =CH2 and n=2-10IC-369:Irgacure 369 (Ciba-Geigy make) 2-benzyl-2-dimethylamino-1-(4-morpholino phenyl) butanone-1HQME: Hydroquinone monomethyl ether [0134]
[Effect of the Invention] According to this invention, the stimulus value Y in the XYZ color system of a septum is 20 or less, by controlling the irregularity of the longitudinal direction of a septum crowning to 0.5-10 micrometers, the contrast of a display is good and the plasma display in which the stable display without malfunction, such as a cross talk in discharge space, is shown is obtained.

[Translation done.]